

Economic Impact Analysis for NIST Laboratory Research Programs

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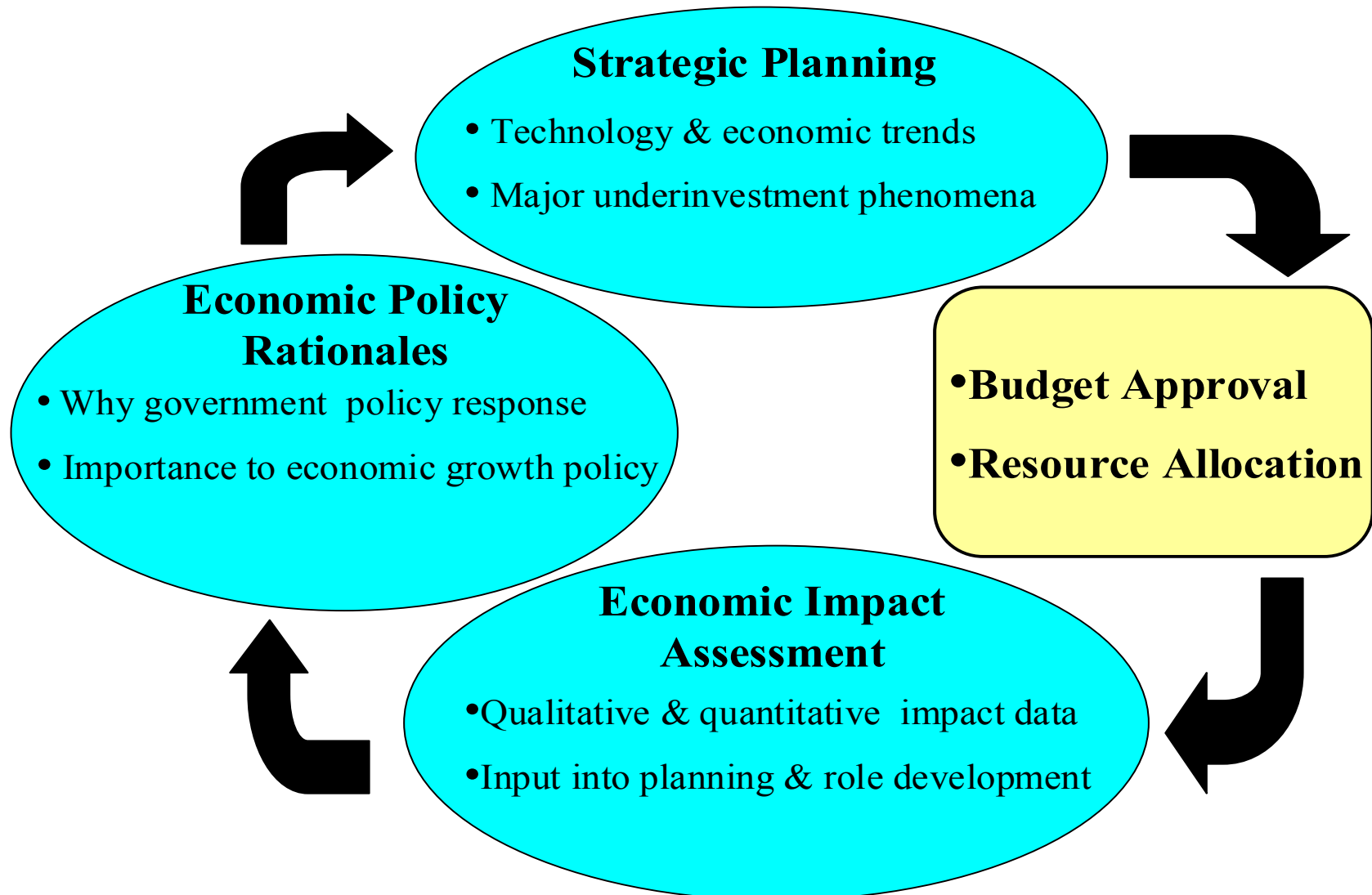
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Economic Analysis

Economic Analysis for Government R&D Programs



Study Design Issues

10 Years of Economic Studies

■ 31 Retrospective Impact Studies

- ⊗ Selection not random
- ⊗ Estimation of benefits limited to *industries directed targeted* by the research project
- ⊗ One to three industries
- ⊗ Usually no extrapolation to other industries

■ 6 Prospective/Planning Studies

- ⊗ Focus is one to three *industry sectors*
- ⊗ Extrapolation to U.S. economy possible

Methodological Approach

Elements of Economic Studies

Technology and Industry Assessment	Economic Analysis Framework	Data Collection Plan	Economic Impacts	Present Results
<ul style="list-style-type: none">▪ Technology trajectories▪ Industry structure and competitive dynamics▪ Technology Infrastructure (TI) roles and trajectories▪ Patterns of underinvestment in TI	<ul style="list-style-type: none">▪ Identification of TI R&D output metrics▪ Determination of outcome or cost metrics▪ Specification of project cost▪ Selection of economic outcome measures▪ Selection of study period	<ul style="list-style-type: none">▪ Determination of industry populations▪ Selection of survey methods▪ Industry introductions▪ Pretest survey▪ Conduct industry surveys▪ Collect government cost data	<ul style="list-style-type: none">▪ Quantitative analysis▪ Qualitative analysis	<ul style="list-style-type: none">▪ Draft report▪ Final report▪ Oral briefings▪ Publications

Methodological Approach

- Use multidisciplinary consultant teams that include
 - technologists
 - industry analysts
 - economists
 - financial analysts
 - survey design specialists
- Apply and adapt conventional techniques of
 - technology assessment
 - microeconomic analysis
 - financial analysis

Output Metrics

- **NIST Laboratories: Infratechnologies**
 - measurement and test methods
 - science and engineering databases
 - quality control algorithms
 - interface protocols
 - test artifacts (SRMs) & services (calibrations)
- **ATP: Generic Technologies**
 - private R&D investment leveraged
 - cumulative patents filed
 - cumulative technologies commercialized

Output Metrics

- **MEP: Technology Transfer**
 - number of firms assisted or projects completed
 - investments/business practices changed
- **National Quality Program**
 - number of firms adopting criteria

Outcome Metrics

- **Investment**

- Follow-on R&D investment (ATP)
- R&D efficiency (Labs)
- reduced R&D cycle time (ATP, Labs, NQP)
- production efficiency (Labs, MEP, NQP)

- **Sales**

- market entry decisions (ATP, MEP)
- new products (ATP)
- market access—interoperability (Labs)
- market penetration—lower transaction costs (Labs)

Outcome Metrics

- **Profits**
 - new markets (ATP, MEP, Labs)
 - increased productivity/quality/reliability (Labs, MEP, NQP)
- **Employment/Wages & Salaries (ATP, MEP)**

Outcome Measures--Quantitative

Example: Profit *Measures*

- Net Present Value
- Benefit-Cost Ratio
- Internal (Social) Rate of Return

Data Quality Issue:

- Corporate outcome data collected in real time
- Only government cost data collected in real time

Outcome Measures--Qualitative

Emphasize Interactions with Technology & Industry

- By stage of economic activity: R&D, production, marketing
- Over technology life cycle
- Supply chain coverage
- Market entry decisions
- Market penetration rates

Microeconomic Impact Assessment

Recent Retrospective Economic Impact Studies: Outputs and Outcomes of NIST Laboratory Research

Industry/Project	Output	Outcomes	Measure
Chemicals: Standards for sulfur in fossil fuels (2000)	<ul style="list-style-type: none"> Measurement methods Reference materials 	<ul style="list-style-type: none"> Increase R&D Efficiency Increase productivity Reduce transaction costs 	IRR: 1,056% BCR: 113 NPV: \$409M
Semiconductors: Josephson volt standard (2001)	<ul style="list-style-type: none"> Measurement methods Reference materials 	<ul style="list-style-type: none"> Increase R&D efficiency Enable new markets 	IRR: 877% BCR: 5 NPV: \$42M
Communications: Data encryption standard (2001)	<ul style="list-style-type: none"> Standard (DES) Conformance test methods 	<ul style="list-style-type: none"> Accelerate new markets Increase R&D efficiency 	IRR: 270% BCR: 58–145 NPV: \$345M–\$1.2B
Communications: Role-based access control (2001)	<ul style="list-style-type: none"> Generic technology Reference models 	<ul style="list-style-type: none"> Enable new markets Increase R&D efficiency 	IRR: 29–44% BCR: 43–99 NPV: \$59–138M
Energy: Gas mixture standard for regulatory compliance (2002)	<ul style="list-style-type: none"> Standard (NTRM) 	<ul style="list-style-type: none"> Increase productivity Reduce transaction costs 	IRR: 221–228% BCR: 21–27 NPV: \$49–63M
Manufacturing: Product design data standard (2002)	<ul style="list-style-type: none"> Standard (STEP) Conformance test methods/facilities 	<ul style="list-style-type: none"> Increase R&D efficiency Reduce transaction costs 	IRR: 32% BCR: 8 NPV: \$180M

IRR=Internal (Social) Rate of Return, BCR=Benefit-Cost Ratio and NPV=Net Present Value.

Microeconomic Impact Assessment

Recent Prospective Economic Studies of Costs due to Inadequate Technology Infrastructure

Focus of Study	Industries Covered	Infrastructure Studied	Estimated Annual Costs
Interoperability costs (1999)	<ul style="list-style-type: none">• Automotive supply chain	<ul style="list-style-type: none">• Product design data exchange standards	\$1 billion
Deregulation (2000)	<ul style="list-style-type: none">• Electric utilities	<ul style="list-style-type: none">• Metering• Systems monitoring/control	\$3.1–\$6.5 billion
Software testing (2002)	<ul style="list-style-type: none">• Transportation equipment• Financial services	<ul style="list-style-type: none">• All stages of the testing cycle	\$60 billion
Interoperability costs (in progress)	<ul style="list-style-type: none">• Transportation equipment• Electronics supply chains	<ul style="list-style-type: none">• Demand, production, procurement, & distribution information exchange	
Medical testing (in progress)	<ul style="list-style-type: none">• Laboratories (calcium, cholesterol, PSA)	<ul style="list-style-type: none">• Quality of measurement assurance	
Service sector R&D—joint with NSF (in progress)	<ul style="list-style-type: none">• Telecommunications• Software• Financial• RD&T	<ul style="list-style-type: none">• R&D classifications• Manufacturing interface	